

APPENDIX F: Visual and Metallographic Analysis of Mixer Parts

A visual examination of three items was performed. The items included:

- the hub portion of the cast mixing blade where the hub connected to the drive shaft of pot 5;
- a piece of the mixing blade believed to be from the same hub/mixing blade casting of pot 5; and
- an approximately 18-inch top section of the pot 5 shaft.

Following the visual analysis, sectioning and metallographic examinations were performed on portions of the hub and the mixing blade fragment.

Except for pot 5, the four large mixing pot shafts from Booster Room 2 remained intact following the blast. The three intact drive shafts still had the hub portion of the cast mixing blade firmly attached to the drive shafts. Because the shafts and hubs of all but pot 5 were accounted for, the remaining hub and the fractured portion of a shaft that were recovered at the site were determined to be those from pot 5.

The analysis found that the mixing blade hub was subjected to extreme shock loading as evidenced by shear bands and internal cracks. The mixing blade metallographic specimen showed the presence of mechanical twins that are an indication that the blade sections had been cold worked. Unlike the hub section, the blade fragment did not contain localized shear bands that are indicative of intense shock loading. From the limited metallographic study, the type of cold working that resulted in the mechanical twins observed in the blade fragment could not be determined.

Based upon the visual examination of the fracture surface of the drive shaft, the primary fracture mode could not be conclusively established. Further fractographic analysis using a scanning electron microscope would be expected to aid in establishing the fracture mode(s). Similarly, the visual examination of the fracture surface on the mixing blade fragment did not permit conclusive identification of the reason(s) for failure.

Interviews of Sierra workers indicated that 50 to 100 pounds of base mix was left in pot 5 at the end of the shift the day before the explosion. The metallurgical analysis concluded that the damage to the hub is consistent with shock loading that could result from contact with high explosive material upon detonation. This evidence strongly suggests that explosives were present in pot 5 when the explosion occurred.

The absence of shock loading on the piece of the mixing blade indicates that it was not in contact with explosives when the explosion occurred. One possible reason for the lack of shock loading is that the fragment may have been from a pot other than pot 5. Alternatively, the blade fragment may have been above the level of the 50-100 pounds of explosive remaining in the pot and thus experienced a less intense shock loading.